Gastric Bypass

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THE mortality and morbidity of a two or three times excess of normal weight is sufficient to encourage the use of vigorous and novel methods of treatment. Operative treatment is justified when other forms of therapy fail, provided an operation is available which is acceptable, safe and effective. Intestinal sidetracking has undesirably allowed the patient to eat unlimited amounts of food and then, to suffer the effects of subsequent diarrhea with loss of fluid, electrolytes and essential nutriments.

Overweight patients commonly have other surgical problems which need attention, for example, giant incisional hernia. Pneumoperitoneum [3] re-establishes adequate intra-abdominal space, but effective and sustained weight reduction is also required for successful hernia repair. This report describes an operation which is designed to control obesity by limiting the intake of food.

After undergoing total gastric resection patients characteristically remain thin. The 90 per cent gastric bypass operation for obesity was designed to create an intake deficiency similar to that which occurs after total gastric resection. The operation is potentially reversible if in future years restitution should be deemed desirable.

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The subcutaneous fat layer is thinner over the costal margin than elsewhere. An incision is made cephalad and parallel to the costal margin, extending from the eighth intercostal space on one side to the eighth intercostal space on the other side which divides the anterior rectus sheath and muscles.[6] The linea alba is split so as to convert the two rectus compartments into one space immediately caudad to the xiphoid. The posterior rectus sheath is divided caudad and parallel to the costal margin. The suspensory ligament of the left lobe of the liver is divided. The stomach is transected at the junction of the upper 10% and the distal 90 per cent. The ligament of Treitz is divided and a short loop retrocolic gastroenterostomy is performed (Fig. 1). The edges of the mesocolon are secured to the 10% gastric pouch. Sutures are taken between the anterior surface of the upper 10% of the stomach and the closed distal segment so as to prevent twisting or intussusception and to prevent stasis in the antrum. This is probably a most important part of the operation in order to prevent antral stasis and the development of jejunal ulcers.

Antral exclusion operations are notorious for producing jejunal ulcers. As far as we have been able to determine, prior to this study no patients have been subjected to exclusion procedures to the extent of the 70 or 90% gastric bypass. Theoretically, there is sufficient acid secreting mucosa excluded with the antrum so that after the stomach is stimulated to secrete acid, the antrum and first part of the duodenum should be bathed in acid gastric juice un-

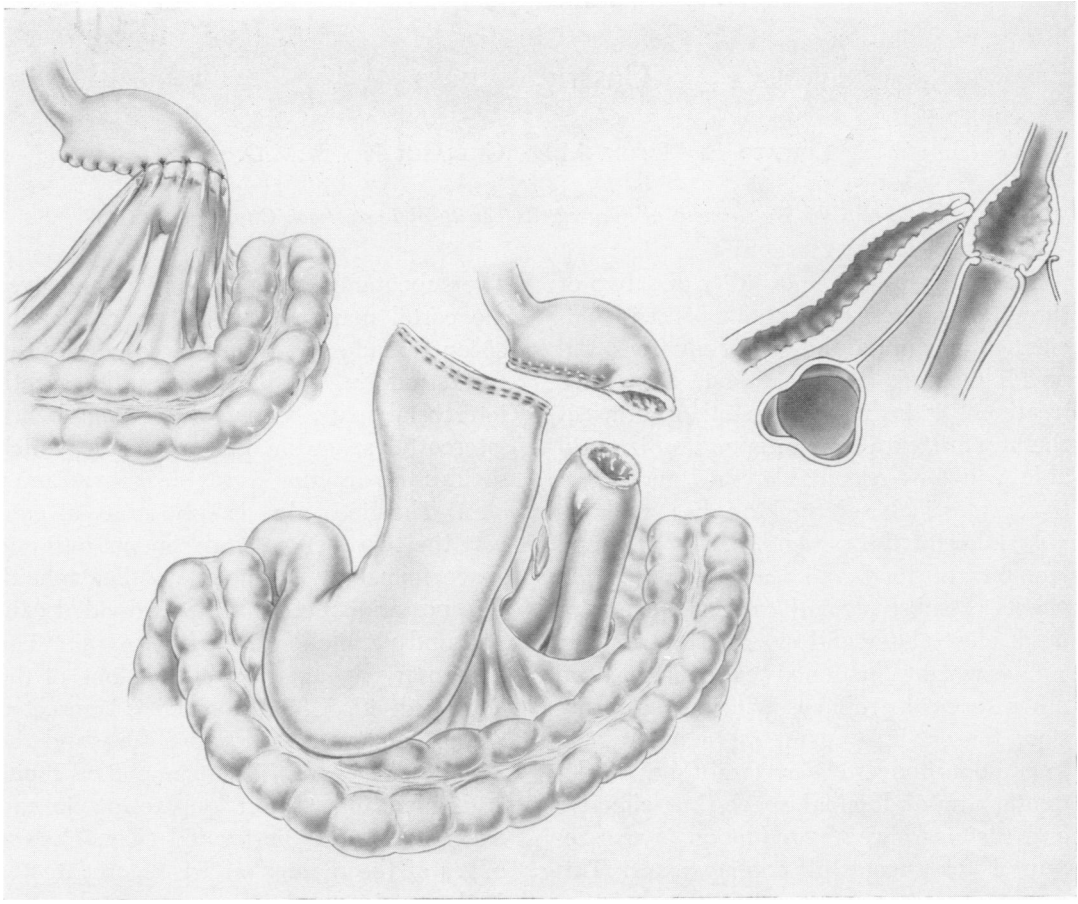

FIG. 1. Illustrates the potentially reversible 90% gastric bypass operation with a short loop, retrocolic gastroenterostomy. The ligament of Treitz is divided. The mesocolon is secured to the 10% stomach pouch and the closed distal 90% of excluded stomach is attached to the anterior wall of the fundic segment. These steps are important in preventing proximal loop stasis.

buffered by food. This should in turn inhibit release of gastrin and thereby tend to regulate gastric secretion at a relatively low level. In addition, the gastroenterostomy and the closure of the distal portion of the stomach diverts food away from the antrum so that there is neither mechanical distention nor chemical stimulation (Fig. 2). The operation in theory should retain inhibitory regulation and decrease stimulation of acid secretion.

This thesis was tested in pouch dogs subjected to a 70% gastric bypass.[4] It was observed that 70% gastric bypass provided almost as much inhibition of secretion as 70% gastric resection. Recently, a study was completed in our laboratory which indicated that gastric bypass also caused a decrease in pancreatic enzyme secretion. This is consistent with the thesis that secretion of gastrin is inhibited after the gastric bypass operation. Emas showed that gastrin stimulates enzyme secretion by the pancreas.[1] It was observed that restitution of the stomach of our pancreatic pouch dogs caused a return of pancreatic enzyme secretion, indicating that the effect of gastric bypass, at least upon pancreatic secretion, is not due to division of vagal nerve fibers in the transected stomach wall.

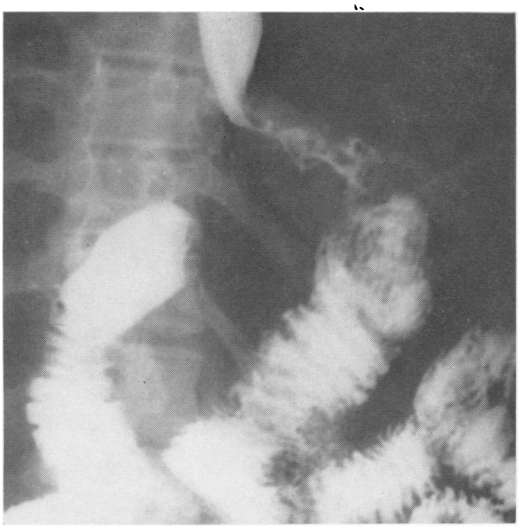

FIG. 2. Appearance of barium in the fundus, proximal loop and duodenal bulb of patient 21 after a 90% gastric bypass for obesity. The excluded stomach does not fill. Patients weight dropped from 328 to 217 in 6 months and is now 195 at 12 months.

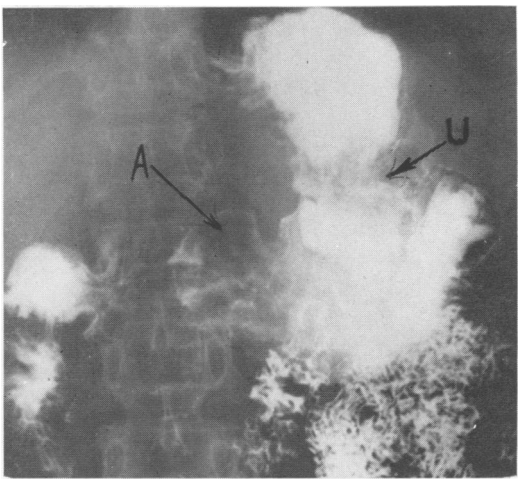

FIG. 3. A roentgenogram of patient 28 taken 3 months after a 70% gastric bypass for treatment of acid peptic disease, shows at A, stasis in the excluded segment and at B, an ulcer at the gastroenterostomy stoma. At reoperation the excluded segment had pulled away from its attachment to the fundic portion.

Results

During the last 3 years this operation has been used in 24 patients who initially averaged 222% of their estimated normal body weight. The patients were equally divided by sex and ranged in age from 22 to 68 years. In percentage of expected normal weight they ranged from 150 to 394 and in pounds from 178 to 650. Two of the 24 obese patients had histories of duodenal ulcer. Eight normal weight patients with duodenal ulcer have also been subjected to a 70% gastric exclusion operation as a part of this study. As a group, these 32 patients have been studied for a total of 34-patient years and the longest single follow-up is 33 months. The analysis of the operation is divided into two portions relating to (1) safety and (2) effectiveness.

On the basis of the above mentioned animal laboratory data, it was decided that it should be safe to use 90% gastric bypass in obese patients, and that there might even be a place for an extensive exclusion operation in the treatment of duodenal ulcer. Two of the overweight patients had histories of duodenal ulcer. In one patient the ulcer was not active at the time of gastric bypass operation. The other patient, a 26-year-old man, weighing 344 pounds, had undergone treatment for 3 years for a sharp, boring pain in the interscapular area. He had bled from a duodenal ulcer 3 years earlier and had received 16 units of blood. The pain became so severe that he drank 3 gallons of milk a day and carried a gallon jug of milk with him while he farmed. Following gastric bypass, he was relieved of pain and has remained free of symptoms for the 22 months of follow-up. Eight patients with low or normal weight who had duodenal ulcers underwent 70% gastric exclusion operations with subsequent relief of symptoms. However, one 54-year-old woman developed a jejunal ulcer after 3 months. Her fasting, intragastric pH was 3.0 preoperatively and increased to 4.4 ten days after operation. The fasting pH decreased to 1.0 two months after gastric bypass. The excluded segment of stomach filled during barium swal-

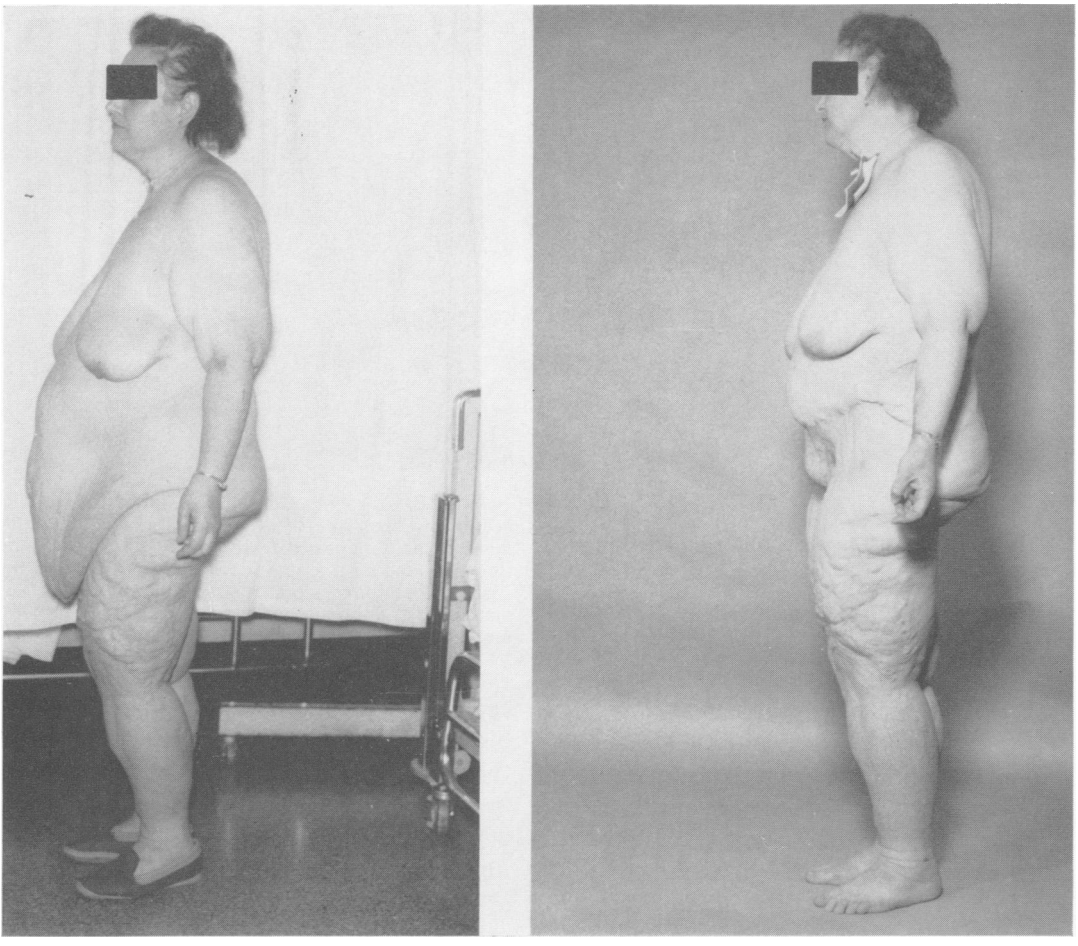

FIG. 4. Patient 19 was admitted for emergency respirator care weighing probably in excess of 600 pounds. After 18 months of dieting in the hospital she weighed 327 pounds and 90% gastric bypass was provided. The two pictures show her weighing 280 pounds 8 months later and 221 pounds 12 months following the bypass and after panniculectomy. She now weighs 212 pounds at 14 months. Five of the patients have had redundant skin removed.

low and emptied poorly and at re-operation this segment was found to be distended and unattached to the fundic pouch (Fig. 3). The development of stasis in the excluded portion of stomach is a real hazard after gastric bypass operation as it may recruit gastrin release and lead to jejunal ulceration.

Two obese patients died following operation. Both patients had multiple ancillary medical and surgical problems which increased the risk of treatment. One died in the hospital from peritonitis and pulmonary congestion. Blood gas and pH studies were consistent with high output respiratory failure. No leaks were found in any of the suture lines. It is probable that peritonitis developed from contamination at the time of operation. Death might have been prevented if respiratory assistance had been provided earlier. The second patient was a 63-year-old woman who originally weighed 259 pounds and underwent operation weighing 225 pounds. She died suddenly 10 days after operation from pulmonary embolus. Two patients had infections in the subcutaneous fat which required opening the length of the wound

TABLE 1. *Summary of Patients Subjected to Gastric Bypass*

Patient Number	Age	Sex	Height	Initial Weight	Operative Weight	Lowest Weight	Months Postop.	Present Weight	Months Postop.	Ancillary Problems at Time of Gastric Bypass and Later Course
1	50	F	57	208	208	136	12	170	33	Hernia repaired 11 months after bypass and after pneumoperitoneum.
2	26	F	66	340	340	294	5	333	11	No exercise or motivation; emotionally unstable; failure in weight control.
3	65	M	—	—	—	—	—	—	32	Duodenal ulcer. No recurrence.
4	61	F	62	178	178	143	6	145	28	Hernia repaired with Marlex at time of bypass. Diabetes improved.
5	52	F	62	276	230	180	27	180	27	Vomits if overeats.
6	55	F	69	275	234	224	3	235	24	Cholecystectomy. Hernia repaired after 10 months. Diabetes improved.
7	68	F	64	246	215	191	10	191	10	Cholecystectomy. Hernia repaired with Marlex.
8	46	F	63	259	225	—	—	—	—	Died 10 days after operation. Probable pulmonary embolus.
9	26	M	75	344	341	267	10	286	22	Severe duodenal ulcer pain relieved and no recurrence.
10	55	M	—	—	—	—	—	—	20	Duodenal ulcer. No recurrence.
11	47	M	76	318	275	250	3	275	20	Diabetes improved. Unable to take care of self. No exercise.
12	61	M	69	272	225	209	5	223	19	Ulcerated hernia repaired after pneumoperitoneum.
13	41	M	—	—	—	—	—	—	17	Duodenal ulcer.
14	60	F	62	225	225	184	11	188	15	Hernia repair 2 months later. Nausea if overeats.
15	44	M	70	270	248	176	14	176	14	Hernia repair 8 months later. Nausea if overeats.
16	31	M	71	370	301	175	13	175	13	Diarrhea relieved by eating more slowly.
17	64	F	—	—	—	—	—	—	12	Duodenal ulcer. No recurrence.
18	22	M	71	317	317	185	13	185	13	Panniculectomy.
19	35	F	67	600	327	212	14	212	14	Cholecystectomy. Panniculectomy. Tracheotomy from time of admission.
20	26	M	71	650	379	325	8	365	12	Cholecystectomy. Panniculectomy.
21	27	F	65	325	328	196	12	195	12	Enthusiastic over appearance and energy.
22	25	M	70	321	286	192	8	202	9	Panniculectomy. Varicose veins stripped.
23	26	M	—	—	—	—	—	—	2	Duodenal ulcer.
24	48	F	—	—	—	—	—	—	4	Duodenal ulcer.
25	57	F	63	317	271	227	4	227	4	Hernia repaired. Wound infection.
26	30	F	63	243	243	202	5	202	5	Vomits if overeats.
27	26	M	69	279	279	228	5	228	5	No complaints.
28	54	F	—	—	—	—	—	—	—	Duodenal ulcer. Jejunal ulcer developed in three months.
29	45	F	69	323	323	280	5	280	5	Hernia repair. Duodenal deformity was present before bypass.
30	46	F	—	—	—	—	—	—	3	Duodenal ulcer. Hiatus hernia repaired.
31	43	M	61	350	203	164	10	164	10	Repeated cardiac failure before bypass was completely relieved after bypass. Stasis ulcers healed. Wound infection. Diarrhea from rich foods.
32	34	M	60	338	200	184	2	184	2	Cholecystectomy.
33	59	F	69	400	350	—	—	—	—	Gallstones. Died, peritonitis and pulmonary congestion.
34	44	M	72	316	316	257	1	257	2	Cholecystectomy. Respirator several weeks. Ischemic, arteriosclerotic heart disease.

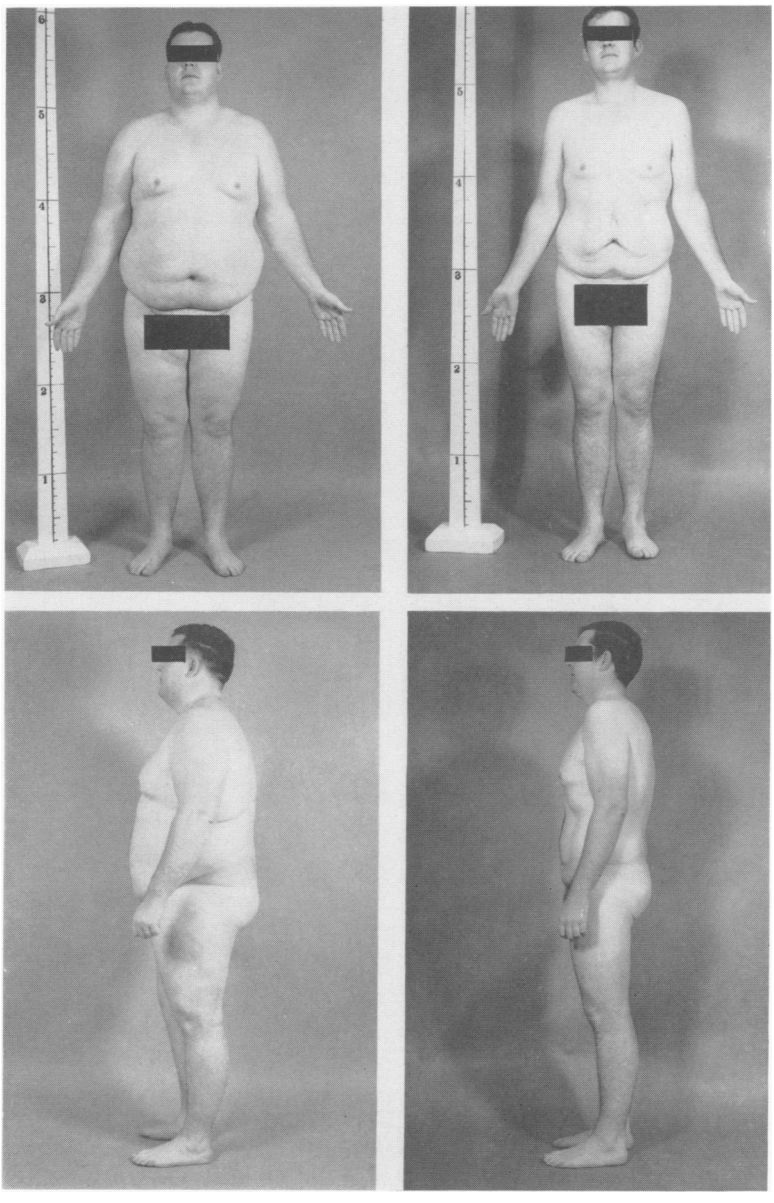

FIG. 5. Patient 18 is shown before and 13 months after gastric bypass. He was initially seen at the request of our Psychiatric Department because of his embarrassment about his weight and his inability to lose weight. He is now working full time and is asymptomatic.

down to fascia. Recently, we have left the skin and subcutaneous tissues open; to be closed after 4 or 5 days with placed, but previously untied, skin sutures.

Several patients have remained in the intensive care area for 1 or 2 days to receive respiratory assistance. One patient required several weeks of respiratory support necessitating a tracheotomy. A 35-year-old patient was admitted weighing 600 pounds and had pneumonia and cyanosis. She required an endonasal, endotracheal tube which led to a stricture of the trachea. She weighed 385 pounds at the time of gastric bypass. Twelve months after operation, and 2½ years after admission, she weighs 217 pounds (Fig. 4). She still has a tracheotomy.

Two patients required re-admission to the hospital after 90% gastric bypass be-

cause of a too-rapid lose of weight. One patient was treated with continuous gavage feeding for 5 days after which she has been able to eat an adequate amount of food. The other patient was effectively treated with adiphenine and phenobarbital for postprandial vomiting. The tendency toward nausea and vomiting from overeating is a fortuitous Pavlovian training mechanism which is present in at least half of the patients after gastric bypass. This is of help in obese patients, but is a drawback when it occurs in thin or normal-weight patients who are treated for duodenal ulcers. Overeating apparently causes proximal loop retention of bile because the vomitus is usually bile and not food.

The effectiveness of the operation in controlling obesity is demonstrated (Table 1) by the preoperative, operative, and most recent weights. None of the patients have as yet reached a normal weight for their height. This may be due to the large amount of connective and supportive tissue where fat had previously been stored. Five of the patients have had redundant abdominal skin removed after losing weight (Fig. 4). The average patient's weight is now 86 pounds less than the initial weight. Ten patients with the least satisfactory response reached a minimum weight in an average of 7 months following operation only to regain an average of 30 pounds. These patients still average 62 pounds lighter than their initial weight. The 12 patients who were studied for one year or more averaged 96 pounds lighter than their initial weight. The typical patient weighed around 317 pounds initially, 275 pounds at the time of the operation, 210 pounds 8 months after operation and 215 pounds after 18 months (Fig. 5).

The cause of the weight loss seems primarily to be due to a decrease in intake of food. Half of the patients do have dumping syndrome symptoms after eating and these symptoms vary in severity from a feeling of warmth to occasional vomiting or diarrhea. Sweets, milk and chocolate are the most commonly mentioned foods which cause symptoms. A number of patients who had nausea, vomiting or diarrhea after eating, had their symptoms relieved after slower eating. Two patients have maintained a weight of 300 pounds by physical inactivity and continuous slow eating. Although the operation is potentially reversible, none of the patients have required reconstitution.

Comment

Haberer[2] reported that jejunal ulcers which occur after exclusion operation develop only in patients who have duodenal ulcers. Of course, the antral exclusion operation which was used during early gastric surgery was physiologically different from the operation which was used in these 32 patients. Only the antrum was excluded prior to 1920 so that the antral mucosa was separated from its normal control by the acid secreting part of the stomach. Haberer reported that a thickened pyloric muscle might contribute to the poor result in antral exclusion. A small Heineke-Mikulicz pyloroplasty was performed only after an ulcer had caused stenosis in our patients.

In view of our limited experience, the gastric bypass operation cannot be recommended for the treatment of acid peptic disease. However, only one of ten patients with duodenal ulcers and none of the 22 obese patients, have thus far developed jejunal ulcers. The majority of patients have elevations of fasting intragastric pH following gastric bypass procedures. The patient who developed a jejunal ulcer had an early return of pH to 1.0. Measurement of intragastric pH[5] appears to be a valuable study both for understanding the physiology of the procedure and in identifying patients in whom there are

risks of jejunal ulcer development after gastric bypass. The patient with jejunal ulcer had regurgitation into and stasis in the excluded segment which was not properly secured to the upper gastric pouch.

Gastric bypass can probably be recommended in the treatment of severe, intractable obesity as it seems unlikely that such patients will develop jejunal ulceration. Patients should weigh at least 200% of their estimated normal body weight if obesity is the only problem. Lesser degrees of obesity can be treated with gastric bypass justifiably if there are other problems; as for example, a patient with a large incisional hernia which cannot be repaired without weight reduction. The physically active, young, or middle-aged adult would seem to be the ideal candidate for 90% gastric bypass provided every effort has been made to control the excess weight by other means.

The timing of the operation and the amount of preoperative weight loss are pertinent to patient safety. The weights at the time of operation have ranged as high as 384 pounds, and ten patients have weighed over 300 pounds. Sixteen patients have had dietary weight reduction in the hospital from a month to as long as 18 months in preparation for operation. The use of pulmonary function studies, blood gas analyses and consultation with anesthesiologists especially experienced in the management of obese patients may make it possible to decrease the time required for preoperative preparation in the hospital. The distribution of fat also influences timing of the operation. A patient who has a relatively thin layer of fat overlying the thoracic cavity can be operated upon at a heavier body weight than a patient whose chest and upper abdomen are encased in a thick layer of fat. Even after partial weight reduction these heavy patients require a great deal of effort and attention. It is important postoperatively to have available an intensive care area where blood gases can be monitored and where volume controlled respiratory support can be provided when necessary. Special long tracheotomy tubes must be available although endonasal, endotracheal tubes are adequate if support is required for only 1 or 2 days.

Summary

Gastric bypass, an extended exclusion operation with gastroenterostomy, has been used in 32 patients. In 24 obese patients (two with duodenal ulcers) 90% of the stomach was excluded and, in eight normal weight patients with duodenal ulcers, 70% of the stomach was excluded. Ulcer symptoms were relieved. One jejunal ulcer developed in a woman whose original problem was duodenal ulcer. The operation is not recommended for treatment of acid peptic disease.

Obese patients respond sufficiently well after weight loss to justify the procedure provided they are physically active, young, or middle-aged people weighing in the range of 200% of estimated normal body weight. Preoperative partial weight reduction in the hospital may be required. Anesthesiologists experienced in care of obese patients, intensive care facilities and volume controlled respiratory support must be available.

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